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Antarctic collected between 1980-2 contained PCB levels of 0.035-0.069 ng/l(3). North Pacific seawater was found to contain levels of 0.04-0.89 ng/l(4). **PEER REVIEWED** [(1) Geyer et al; Ecotox Environ Saf 8: 129 (1984) (2) Marchand M, Caprais JC; Marine Pollut Bull 16: 78-81 (1985) (3) Tanabe S et al; Chemosphere 12: 277-88 (1983) (4) Tanabe S et al; Arch Environ Contam Toxicol 13: 731-8 (1984)

6. RAIN/SNOW: Precipitation samples collected throughout Canada during 1975-6 contained PCB levels from 0-45 ug/l(1). A review of reported monitoring data found the following typical atmospheric precipitation concentrations (ng/l) of PCBs at various locations: urban (10-250), rural (1-50), Great Lakes (10-150), marine (0.5-10), remote (1-30)(2). Analysis of rainwater from two open-lake locations in Lake Superior in 1983 found PCB levels of 0.8-48.0 ng/l(3). Snow and ice from Antarctica was found to contain levels of 0.16-1.0 ng/l(4). Levels up to 158 ug/l (1975-78) found in Canada, USA and Europe with levels decreasing to 1988 (PCBs)(5). **PEER REVIEWED** [(1) Brooksbank P; The Canadian Network for Sampling Organic Compounds in Precipitation. Tech Bull No 128, Ottawa, Canada: Environment Canada (1983) (2) Eisenreich SJ et al; Environ Sci Technol 15: 30 (1981) (3) Strachan WMJ; Environ Toxicol Chem 4: 677-83 (1985) (4) Tanabe S et al; Chemosphere 12: 277-83 (1983) (5) Mazurek MA, Simoneit BRT; CRC Crit Rev Environ Control 15: 41-5 (1985)
7. Concn of polychlorinated biphenyls (PCBs) and other contaminants were determined on large vol surface water samples collected throughout Lakes Ontario, Erie, Huron, and Superior in the spring of 1986. PCBs exhibited significant differences between lakes. PCB mean sample concn were 0.37 (Lake Superior), 0.631 (Lake Huron), 0.686 (Georgian Bay), 1.378 (Lake Erie), and 1.410 ng/l (Lake Ontario). Determinants of large-scale spatial patterns of contaminants varied between lakes. Minor north-south gradients in contaminant concn in Lake Superior appeared largely a function of differences in atmospheric loading. In contrast, large gradients were evident in Lake Erie, a result of numerous tributary point sources, particularly in the western basin. The Niagara River was the most important determinant of spatial patterns of contaminants in Lake Ontario. **PEER REVIEWED** (Stevens RJJ, Neilson MA; J Great Lakes Res 15 (3): 377-93 (1989)
8. In preparation of remedial action plans for the St. Clair, Detroit, and St. Mary's rivers, a planning-level methodology for evaluation of pollutant loadings from urban nonpoint sources was developed and applied in 3 Canadian cities: Sarnia, Sault Ste. Marie, and Windsor. and mean constituent concn, estimated from field sampling, to produce estimates of annual pollutant loadings. The mean stormwater concn and point source equivalent concn (ug/l) for polychlorinated biphenyls (PCBs) were 0.179 and 0.179 for Sarnia, 0.0259 and 0 for Sault Ste. Marie, and 0.0858 and 0.641 for Windsor, respectively. **PEER REVIEWED** (Marsalek J, Ng HYF; J Great Lakes Res 15 (3): 444-51 (1989)

Effluents Concentrations:

1. Analysis of sewage sludge from 23 American cities found PCB levels ranging from 0.15-3.1 ppm(1). The average PCB concn (Aroclor 1242 + 1260) emitted from gas vents at a hazardous waste landfill in NC was found to be 126 ug/cu m(2). PCB concentrations of 0.01-1.5 ppm were detected in the fly ash from five municipal incinerators operating under different technological and working conditions(3).

PCB levels of 0.3-3.0 ug/cu m were detected in the stack effluents from several midwest municipal refuse and sewage incinerators(4). The total PCB concn measured in the flue gas effluent from a municipal refuse incinerator in OH was 0.26 ug/cu m(5). **PEER REVIEWED** ((1) Mumma RO et al; Arch Environ Contam Toxicol 13: 75-83 (1984) (2) Lewis RG et al; Environ Sci Technol 19: 986-91 (1985) (3) Morselli L et al; Annali di Chimica 75: 59-64 (1985) (4) Murphy TJ et al; Environ Sci Technol 19: 942-6 (1985) (5) Tiernan TO et al; Chemosphere 12: 595-606 (1983)

Sediment/Soil Concentrations:

1. Mean PCB concentrations of about 5-60 ug/kg were detected in the soil in the vicinity of a waste treatment and incineration facility in the United Kingdom during 1984-6 monitoring(1). Analysis of soils from 37 states in 1972 found PCBs in only 2 of 1483 samples, however, the detection limits were only 0.06-0.1 ppm(2). Sediment cores from Milwaukee Harbor (0-60 cm depth) contained PCB levels of 1.03-13.4 mg/kg(3). Analysis of 99 soil samples from urban and rural sites in Great Britain to determine background levels found PCB levels of 2.3-444 ppb with mean and median values of 22.8 and 7.2 ppb, respectively(4). PCB levels of 0-1200 ug/kg were detected in the bottom material of 19 selected streams in the Potomac River Basin(5). Levels of 98-540 ng/g detected in surface sediments of four remote high altitude lakes in the Rocky Mt National Park(6). PCB concentrations ranging from <1-33 ppb were detected in the soils of the Everglades National Forest in FL(7). **PEER REVIEWED** [(1) Badsha et al; Chemosphere 15: 947 (1986) (2) Carey AE et al; Pestic Monit J 12: 209 (1979) (3) Christensen ER, Lo CK; Environ Pollut (Ser B) 12: 217 (1986) (4) Creaser CS, Fernandes AR; Chemosphere 15: 499 (1986) (5) Foltz HR; Significance of Bottom Material Data in Evaluating Water Quality, Ann Arbor Sci 1: 271 (1980) (6) Holt M et al; Wat Air Soil Pollut 22: 403-18 (1984) (7) Requejo AG et al; Environ Sci Technol 13: 931-6 (1979)
2. /IN 1972/ ... SURVEY OF AGRICULTURAL SOILS THROUGHOUT USA PCB'S. IN URBAN AREAS, FREQUENCY & LEVELS ... WERE HIGHER: 12 OF 19 SOIL SAMPLES FROM METROPOLITAN AREAS (63%) SHOWED DETECTABLE LEVELS. **PEER REVIEWED** [IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer,1972-PRESENT. (Multivolume work).,p. V18 82 (1978)
3. Polychlorinated biphenyls (PCBs) were among anthropogenic organic contaminants measured in 33 sediment samples collected in the Trenton Channel of the Detroit River, connecting Lake St. Clair and Lake Erie. Analysis was by electron capture, negative ionization gas chromatographic mass spectrometry. Total PCB (sum of Cl3 to Cl10 homologs) concentrations ranged from none detected to 13,000 ng/g dry weight of sediment at Station 77 (near Monguagon Creek and the Federal Marine Terminal) and 14,000 ng/g near Elizabeth Park. The PCBs were skewed toward the higher chlorine homologs (Cl8 to Cl10). Sediment samples collected at the shore of Fighting Island and on the southern shore of Gross Ile showed <100 ng/g of PCBs. **PEER REVIEWED** [Furlong ET et al; J Great Lakes Res 14 (4): 489-501 (1988)
4. The concentrations of polychlorinated biphenyl congeners were determined in Lake Ontario sediments. Surficial sediments had a reasonably uniform contaminant distribution throughout the sedimentation basins, with no strong plumes to sources. Mean concentrations of

polychlorinated biphenyls (ng/g) in the basins of Lake Ontario were 510 + or - 160 in Niagara, 690 + or - 220 in Mississauga, 630 + or - 340 in Rochester, and 200 + or - 150 in Kingston. Sediment samples outside the sedimentation basins displayed very low contaminant concentrations, averaging of 4 ppb. Sediment trap studies showed that a considerable amount of sediment resuspension occurs in the lake, especially when it is unstratified during the winter. Sediment core studies showed peak discharges of the contaminants occurred in the late 1960s, in good agreement with production and usage history. **PEER REVIEWED** [Oliver BG et al; Environ Sci Technol 23 (2): 200-8 (1989)

5. Using gas chromatography with a (63)Ni electron capture detector on a capillary column, polychlorinated biphenyls were analyzed in surface soil samples (0.5 cm) collected from 49 different locations (remote, rural and urban) in Wales in order to define the background levels of contamination. The polychlorinated biphenyl concentrations ranged from < 0.2 to 12.2 ug/kg of soil, with mean and median of 3.1 and 2.5 ug/kg, respectively. The higher levels were found in soil samples collected from the industrial south east of Wales. Soil properties, such as organic matter or clay content, were not found to correlate with the polychlorinated biphenyl content of the soils. **PEER REVIEWED** [Jones KC; Chemosphere 18 (7-8): 1685-72 (1989)
eastern Lake Ontario and analyzed for several high molecular wt chlorinated hydrocarbons (including PCB's). The 2 sites are geographically proximate but differ in sedimentation rate, permitting sedimentation dependent processes to be factored out. Vertically integrated numbers of deposit feeding oligochaete worms and burrowing organisms are insufficient to homogenize the sediment on the time scale of PCB inputs, which are non steady state. Accumulation and diagenesis of PCBs was examined in the 2 cores, where bioturbation is inferred from radionuclide profiles and organism density. The apparent molecular diffusion coefficient modeled for PCB was about (1 to 3)X10-9 sq cm/sec. The PCB profiles are characterized by a subsurface peak, decr concn to the surface, and an exponential decr in concn below. The concn peaks occur at 3 to 6 cm in the 2 cores. PCB accumulation rates in these cores incr dramatically in the early 1950s, peak in 1966 to 1969 at approx 40 ng/sq cm-yr, and decr to recent rates of 10 to 20 ng/sq cm-yr, perhaps 50% of which is due to upward mixing by oligochaetes. The PCB accumulation rates for 1980 + or - 1 yr are 12.9 and 17.6 ng/sq cm-yr. **PEER REVIEWED** [Eisenreich SJ et al; Environ Sci Technol 23 (9): 1116-26 (1989)

Atmospheric Concentrations:

1. PCB levels of 4.4 and 7.1 ng/cu m were found in the ambient air of Columbia, SC and Boston, MA, respectively, in 1978(1). A review of reported monitoring data found the following typical atmospheric concentrations (ng/cu m) of PCBs at various locations: urban (0.5-30), rural (0.1-2), Great Lakes (0.4-3), marine (0.05-2), remote (0.02-0.5)(2). The total mean Aroclor concentration in the indoor air of a number of public buildings (schools, offices) using PCB transformers in Minnesota during 1984 was found to be nearly twice as high as buildings not using PCB transformers (457 vs 229 ng/cu m) with all indoor air levels significantly higher than typical ambient outdoor air levels(3). Analysis of ambient air at Syowa Station, Antarctica between 1981-2 found PCB levels

of 0.02-0.18 ng/cu m(4). PCB levels in indoor air may be high relative to outside air, especially where pre-1972 fluorescent lighting and video display terminals are being utilized; also in buildings equipped with transformers containing PCBs(5). **PEER REVIEWED** [(1) Bidleman TF; Atmos Environ 15: 619 (1981) (2) Eisenreich SJ et al; Environ Sci Technol 15: 30 (1981) (3) Oestmen L, Roy R; Bull Environ Contam Toxicol 37: 481-7 (1986) (4) Tanabe S et al; Chemosphere 12: 277-83 (1983) (5) USEPA; Drinking Water Criteria Document of Polychlorinated Biphenyls (PCBs) ECAO-CIN-414, IV-29,30 (1987)

2. Fourteen chromatographically well-separated PCB congeners were analyzed in filtered air, in particulates, and in rain collected simultaneously in the city of Kiel, FRG. Data are presented on 4 sets of PCBs. The PCB mixture was dominated by congeners with a low degree of chlorination chlorination (n Cl = 4 to 6) in aerosols and in rain. The summation of PCB concn were in the range 477 to 4947 pg/cu dm. The composition of PCB mixtures in rain samples was remarkably constant, similar to findings for the vapor phase and aerosols. The vapor phase represented up to 99% of total atmospheric concn for the most volatile congeners. Particle scavenging was the dominant source of PCBs in rain, despite the small contribution (only 1 or 2%) of particulate PCBs to the total atmospheric concn. **PEER REVIEWED** [Duinker JC, Bouchertall F; Environ Sci Technol 23 (1): 57-62 (1989)

Other Standards and Regulations

Water Standards:

1. The levels of polychlorinated biphenyls in ambient water which may result in an incremental cancer risk of 1X10-5, 1X10-6, and 1X10-7 over an individual lifetime are estimated to be 0.79 ng/l, 0.079 ng/l, and 0.0079 ng/l, respectively. On the basis of the consumption of aquatic organisms alone, the corresponding levels in ambient water are estimated to be 0.79 ng/l, 0.079 ng/l, and 0.0079 ng/l, respectively. **PEER REVIEWED** [USEPA; Ambient Water Quality Criteria Doc: Polychlorinated Biphenyls p.vii (1980) EPA 440/5-80-068
2. For polychlorinated biphenyls the criterion to protect freshwater aquatic life as derived ... is 0.014 ng/l as a 24 hr average. The concn of 0.014 ng/l is probably too high because it is based on bioconcentration factors measured in laboratory studies, but field studies apparently produce factors at least ten times higher for fishes. The available data indicate that acute toxicity to freshwater aquatic life probably will only occur at concentrations above 2.0 ng/l and that the 24 hr average should provide adequate protection against acute toxicity. **PEER REVIEWED** [USEPA; Ambient Water Quality Criteria Doc: Polychlorinated Biphenyls p.vi (1980) EPA 440/5-80-068
3. For polychlorinated biphenyls the criterion to protect saltwater aquatic life as derived ... is 0.030 ng/l as a 24 hr average. The concn of 0.030 ng/l is probably too high because it is based on bioconcentration factors measured in laboratory studies, but field studies apparently produce factors at least ten times higher for fish. The available data indicate that acute toxicity to freshwater aquatic life probably will only occur at concentrations above 10.0 ng/l and that the 24 hr average should provide adequate protection against acute toxicity. **PEER REVIEWED** [USEPA; Ambient Water Quality Criteria

8. Nat'l Research Council Canada; Polychlorinated Biphenyls: Biological Criteria for an Assessment of their Effects on Environmental Quality (1978) NRCC No. 16077.
9. Nat'l Research Council Canada; A Case Study of a Spill of Industrial Chemicals- Polychlorinated Biphenyls and Chlorinated Benzenes (1980) NRCC No. 17586.
10. NAS/National Research Council; Polychlorinated Biphenyls (1979).
11. Ming Lin J, Que Hee S; Am Ind Hyg Assoc J 48 (7): 599-607 (1987). A comparison of various analytical methods for Arcolor is presented.
12. DHHS/ATSDR; Toxicological Profile for Selected PCBs (Arcolor-1260, -1254, -1248, -1242, -1232, -1221, and -1016 (6/89)
13. USEPA; Drinking Water Quality Criteria Document: Polychlorinated Biphenyls (PCBs) ECAO-CIN-414 (1987)
14. DHHS/NTP; Fifth Annual Report on Carcinogens (Summary) (1989) NTP 89-239
15. DHHS/NTP; Sixth Annual Report on Carcinogens (1991)

OHM/TADS
Topic: POLYCHLORINATED BIPHENYLS

Persistency:
HIGH: HIGHLY CHLORINATED FORMS OF PCBS CONTAINING 5 OR MORE CHLORINE ATOMS PER BIPHENYL MOLECULE ARE MUCH MORE PERSISTENT IN THE ENVIRONMENT THAN PCBS CONTAINING 1,2, OR 3 CHLORINE ATOMS. TETRACHLOROBIPHENYLS ARE CONSIDERED INTERMEDIATE IN PERSISTENCE. (AWQC** PS81-117796,80/ECAO) ENVIRONMENTALLY, APPROXIMATELY ONE CHLORINE ATOM OF EACH CHLORINATED BIPHENYL IS LOST PER YEAR. (39KDAS 56,78/BUN) MICROBIAL AEROBIC DEGRADATION STUDIES USING MIXED CULTURES IN WATER INDICATED
Water uses threatened:
FISHERIES POTABLE SUPPLY RECREATION.
Industrial fouling potential:
NOT ACCEPTABLE IN FOOD PROCESSING WATERS.
Air pollution:
TOXIC. VOLATILIZES SLOWLY FROM BODIES OF WATER.

TOMES(R) Hazard Management
Topic: POLYCHLORINATED BIPHENYLS

G. OTHER
1. Mixtures of PCBs were found in amounts between 5 and 6000 ppb in paper products made of recycled material. The PCB content of products made from Central-European raw materials were higher than those from Finnish material. The origin of some high content samples is unknown (Welling et al, 1992).
3. The major source of polychlorinated biphenyl release to the environment is an environmental cycling process of polychlorinated biphenyls previously introduced into the environment. This cycling process involves volatilization from the ground surface (water, soil) into the atmosphere with subsequent removal from the atmosphere via wet/dry deposition and then revolatilization (HSDB, 1991).
4. Polychlorinated biphenyls are also currently released to the environment from landfills containing polychlorinated biphenyl waste materials and products, incineration of municipal refuse and sewage sludge, and improper (or illegal) disposal of polychlorinated biphenyl materials, such as waste transformer fluid, to open areas (HSDB, 1991).